DOCUMENT RESUME

ED 209 919 FL 012 622

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TITLE Information Structures and Pedagogic Applications.
PUB DATE Sep 81
NOTE 18p.; Paper presented at the Annual Meeting of the British Association for Applied Linguistics (Sussex, England, September 18-20, 1981). Faint type.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Paragraphs; *Reading Comprehension; Second Language Instruction; *Structural Analysis (Linguistics); *Writing (Composition); *Writing Evaluation; Writing Processes

ABSTRACT

The underlying structure of meaning in a text is to a certain extent belied by the surface structure, or sequential organization, of the text. The underlying information structures (IS) organize information according to cognitive and cultural factors. It may be demonstrated that just three major IS with various subvarieties can describe any text: (1) "processes" represent events, (2) "constitutives" represent states, and (3) "comparatives" represent a second level as they must involve two other IS that are being compared. The major IS may be graphically diagrammed. A preferred pattern of exposition of information varies according to factors that are either stylistic or linguistic. A well-written text contains "markings" which reveal the information structure and make comprehension possible no matter how much information is being presented. Paragraph analysis based on the IS concept is useful in ascertaining readability of texts for use in, for instance, the second language classroom. IS offer the added advantage of permitting objective evaluation of writing. (JB)

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INFORMATION STRUCTURES AND PEDAGOGIC APPLICATIONS

F. Chambers, University of Essex

Information structures are intended to diagrammatically record the semantic relationships that hold between logically related elements in extended discourse.

Initially I will talk in terms of the application of information structures (I.S.) to referential rather than evocative discourse and concern myself with the written rather than the spoken word as it is in these areas that I.S. can be most clearly seen and described.

Given that referential writing involves presenting ideas containing varying degrees of facts and opinions in some kind of reasoned way, we are concerned with establishing and formalising the logical base of the relatedness of facts in discourse.

One suggested solution might be to employ the various systems of logic (predicate, propositional, modal etc.) but these are not suitable for our purpose because of:

a) their complexity

b) their lack of sensitivity

So we have to look elsewhere.

Typically the type of extended referential discourse that we are considering can be seen as a linear co-ordination of facts.

"A relates to B which implies C which is caused by D ....."

and so on. It would be very strange discourse that handled facts in an unconnected manner.

But this is very much a surface representation. Each fact is related either overtly or covertly to the next one, but the 'next' fact is not necessarily either in cannonical order or even the most closely related fact. Underlying these surface organisations are a series of patterns of logical

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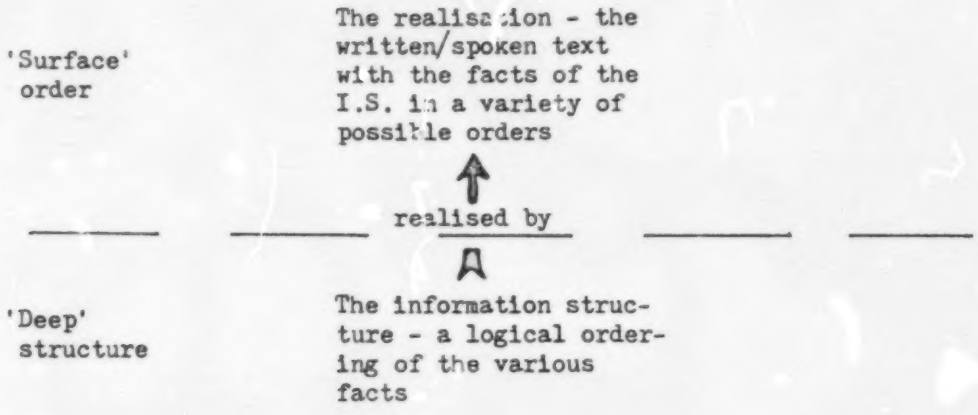
relationships that can be represented as information structures - diagrammatic illustrations of the relationships between different aspects of information that together present some larger expository function. Thus we have the text or surface structure and the information structure - a realising structure and a realised structure, which has been negotiated[1] in a particular manner.


'Surface' order
The realisation - the written/spoken text with the facts of the I.S. in a variety of possible orders
realised by
'Deep' structure
The information structure - a logical ordering of the various facts

A text example may clarify what I'm saying. Consider the passage 'Varicose Veins':

> The valves of the venous system are frequently destroyed. This occurs particularly when the veins have been overstretched by an excess of venous pressure for a prolonged period of time, as occurs in pregnancy or when one stands on his feet most of the time. Stretching the veins finally destroys the function of the valves entirely. Thus, the person develops 'varicose veins', which are characterised by large bulbous protrusions of the veins beneath the skin of the entire leg and particularly of the lower leg. The venous and capillary pressures become very high, and leakage of fluid from the capillary blood into the tissues causes constant oedema in the legs of these persons whenever they stand

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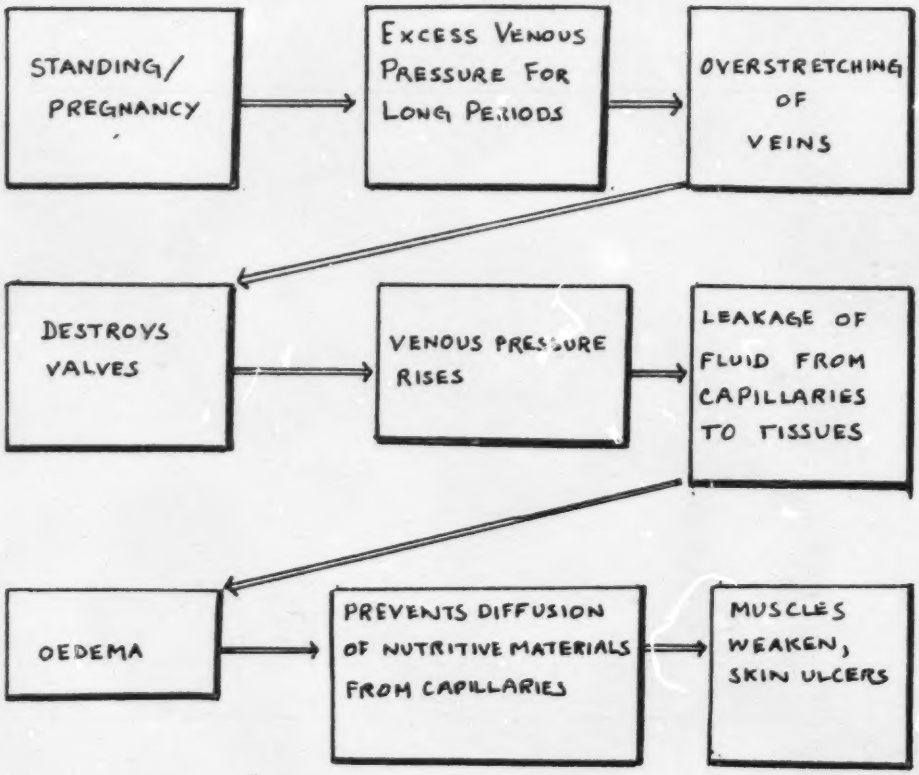
[1] The term 'negotiated' was introduced by Johns (1980). However this term already has a useful meaning in the field of discourse analysis when we talk of 'negotiating conversation' and therefore I prefer and will use from now on the term 'realised' to indicate the transformation from 'deep' to 'surface' structure.

for more than a few minutes. The oedema in turn prevents adequate diffusion of nutritional materials from the capillaries to the muscle and skin cells so that the muscles become painful and weak, and the skin frequently becomes gangrenous and ulcerates.

A.C. Guyton, M.D. Basic Human Physiology: Normal Function and Mechanisms of Disease. W.B. Saunders Company, Philadelphia (1977) p.203.

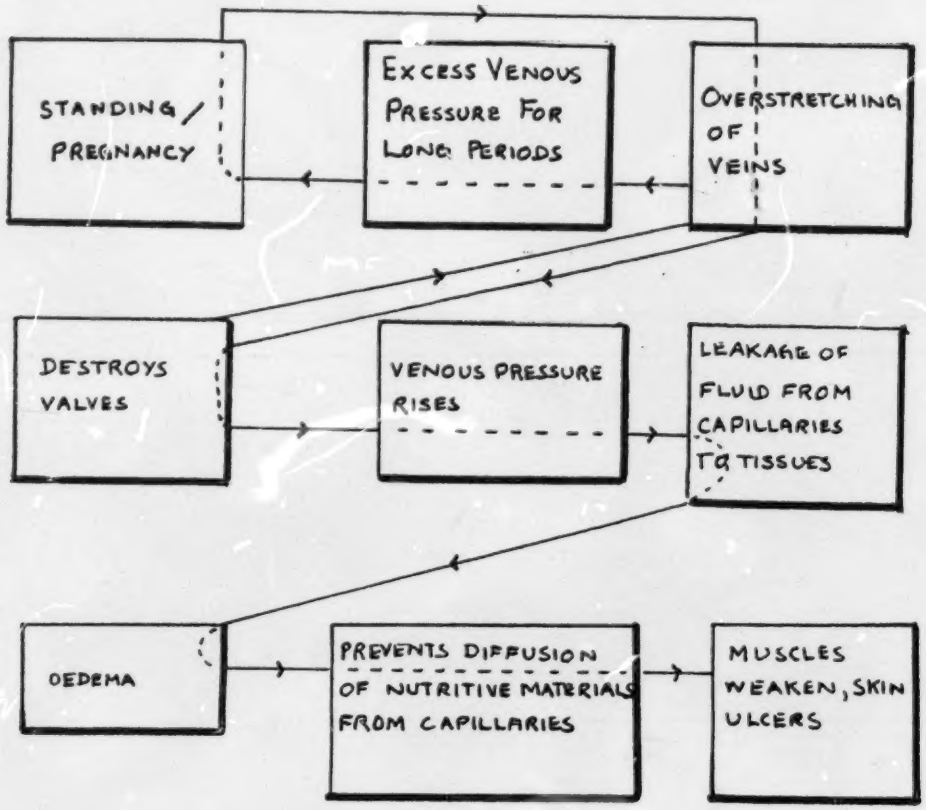
This has a causally related information structure that may be represented as:



From A.C. Guyton. Basic Human Physiology. W.B. Saunders 1979, p.203.

Information structure: Process - Causative

However that is realised for various reasons that will be considered below, as a surface structure in the order


STANDING / PREGNANCY
EXCESS VENOUS PRESSURE FOR LONG PERIODS
OVERSTRETCHING OF VEINS
DESTROYS VALVES
VENOUS PRESSURE RISES
LEAKAGE OF FLUID FROM CAPILLARIES TO TISSUES
OEDEMA
PREVENTS DIFFUSION OF NUTRITIVE MATERIALS FROM CAPILLARIES
MUSCLES WEAKEN, SKIN ULCERS

Realisation: Process - Causative

Thus the I.S.

a) reduce by (i) deletion
(ii) combination

b) organise information

in the manner of van Dijk (pp 103-108, 1977), thus permitting maximum cognitive information with minimum cognitive effort by presenting the information in a structured manner. Such cognitive effort is controlled by accepted cognitive factors, e.g. gestalts, as well as existant culture. "Prototypes are convenient fictions that must be learned" (Rosch and Lloyd, 1978, passim) but the evidence that such prototypes play a critical role in human categorisation is quite considerable. However I would like to stress that I.S. are only models of possible extended prototypes, and not a theory in themselves.

By itself our observations concerning the passage would be trivial and obvious. It becomes much more interesting if we find that a limited number of I.S. can handle more or less any referential text.

And such is the case for it seems that just three major I.S. with various sub-varieties can, combined in a number of ways, describe any such text.

The Major I.S. and Their Variations

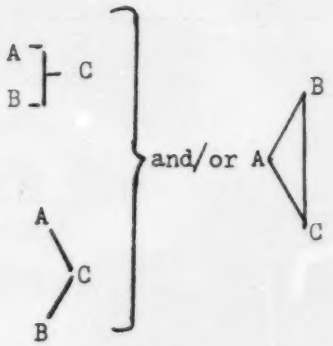
(1) Processes (Causative and Chronological)

a) Simple

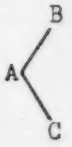
A ⟶ B ⟶ C

b) Branching

(i) 'or'

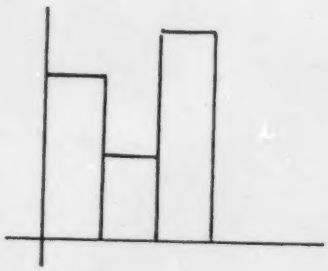


(ii) 'and'

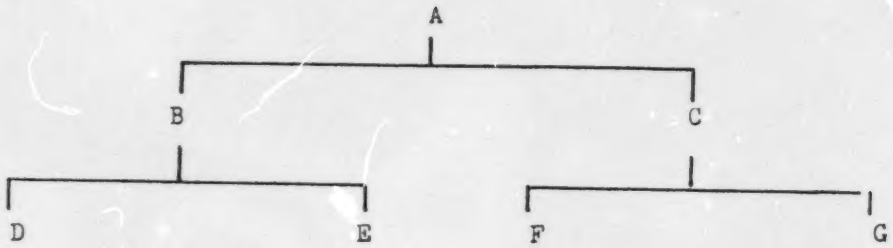


Constitutives

a) Quantitative

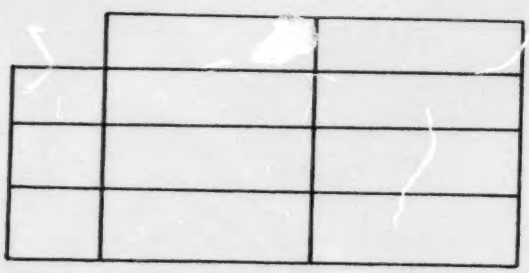


b) Non-quantative

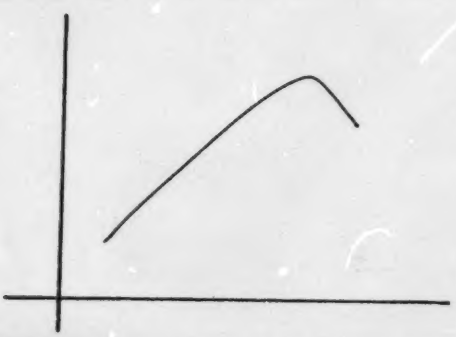


Comparatives

a) Discrete



b) Non-discrete



Let us briefly consider each separately.

Processes represent events.

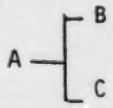
These can either be

a) simple A ⟶ B ⟶ C

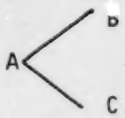
or b) branching

either

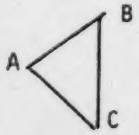
i) 'and'



ii) 'or'



iii) 'and'/'or'

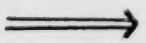


thus handling the problem of the classical logical connectives.

The important factor of the type of relationship between propositions can be handled by different symbols between boxes.

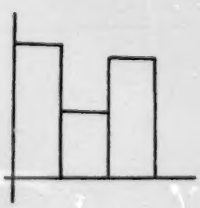
implies

precedes


causes

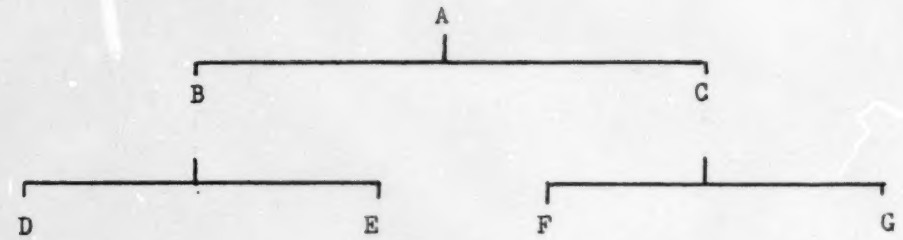
Constitutives represent states.

Quantitatives constitutives can be represented either by:



which can be considered as informationally equivalent.

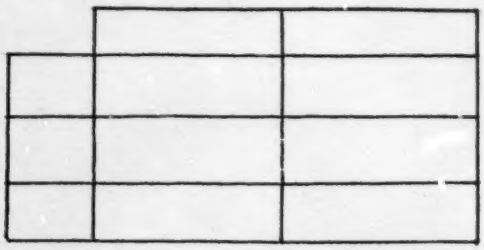
Non-quantitatives constitutives can be represented by



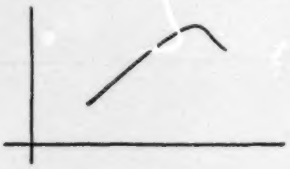
Maps and plans combine constitutive and relative position, and so forth.

Comparitives are some kind of second level representative as they must always involve two other I.S. that are being compared. Generally these can be represented either in two or three dimensions.[1]

a) matrix (for discrete information)



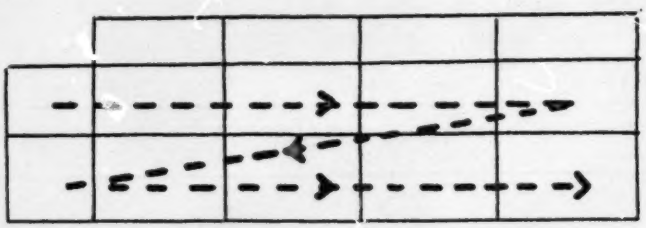
b) graphs (for non-discrete information)



Having outlined the major I.S. I would like to consider the question of their realisation.

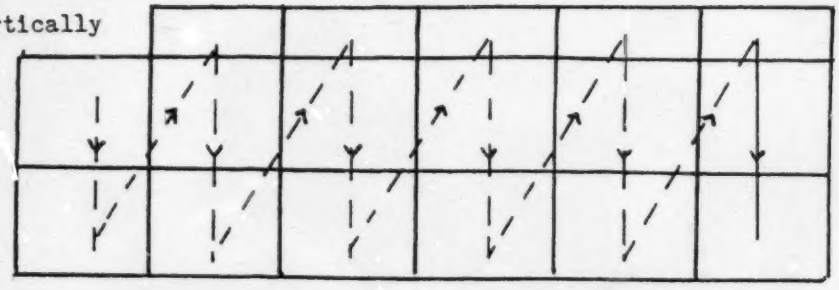
Generally one might expect a preferred pattern of exposition, 'top to bottom, left to right' so that information in a matrix might be realised either:

a) horizontally



[1] The number of dimensions that can be illustrated is limited but this is a limitation of illustrations rather than of the model. I believe it is possible for catastrophe theory to represent up to seven dimensions though personally I cannot conceive these. R. Atkin ((1981) Multidimensional Man, Penguin) talks in terms of 20 dimensions, but still represents them, of course, in 2 dimensions.

or b) vertically



However there is a great deal of variation possible, and in fact for various reasons these 'unmarked' forms are rarely met.

Factors which might affect the realisation seem to be either:

a) stylistic

b) linguistic

By 'stylistic' reasons I refer to the tendency of authors to deviate from the unmarked form for reasons of what Johns (ibid) refers to as 'elegant variation'.

Returning to the basic division into event and state relations, these seem to be explicable in terms similar to those of van Dijk (1977), as mentioned above.

For event Relations the unmarked form would be either temporal or causal.

For State Relations the unmarked form would be:

general to particular

whole to part

set to subset

However marked forms frequently occur caused by: (see van Dijk, pp224-5, 1977)

a) order of observation/perception/understanding of fact sequence.

b) order of information transmission

e.g. A wishes to tell B about q. q involves prior p. Whether p is mentioned depends upon assumptions A makes about B prior state of knowledge.

c) order of illocutionary act.

e.g. if the meat is burned the hostess may state this first as being the primary matter before explaining that it is a new oven which may also then be followed by the fact that this is the first time she has used an electric cooker.

d) order of reference.

To ensure coherence and cohesion a writer may commence with an item that has just been previously referred to. For instance, the text on varicose veins begins with mention of the valves because valves had just been the topic of the previous paragraph, although damage to the valves is a relatively late item in 'logical' order.

Such perigrinations are normal but should be closely controlled.

Consider the text "Big Ben":

Big Ben is one of the most famous clocks in the world. Strictly speaking the name does not refer to the whole clock but only to the bell that tolls the hours. The original bell was cast on 6th August 1856 at Norton near Stockton-on-Tees. A pair of furnaces each able to take ten tons of metal had been prepared the month before and pouring in the metal took over an hour. At the beginning of the following year the 16-ton bell was hung in New Palace Yard in London where it was rung for fifteen minutes each week to test its tone.

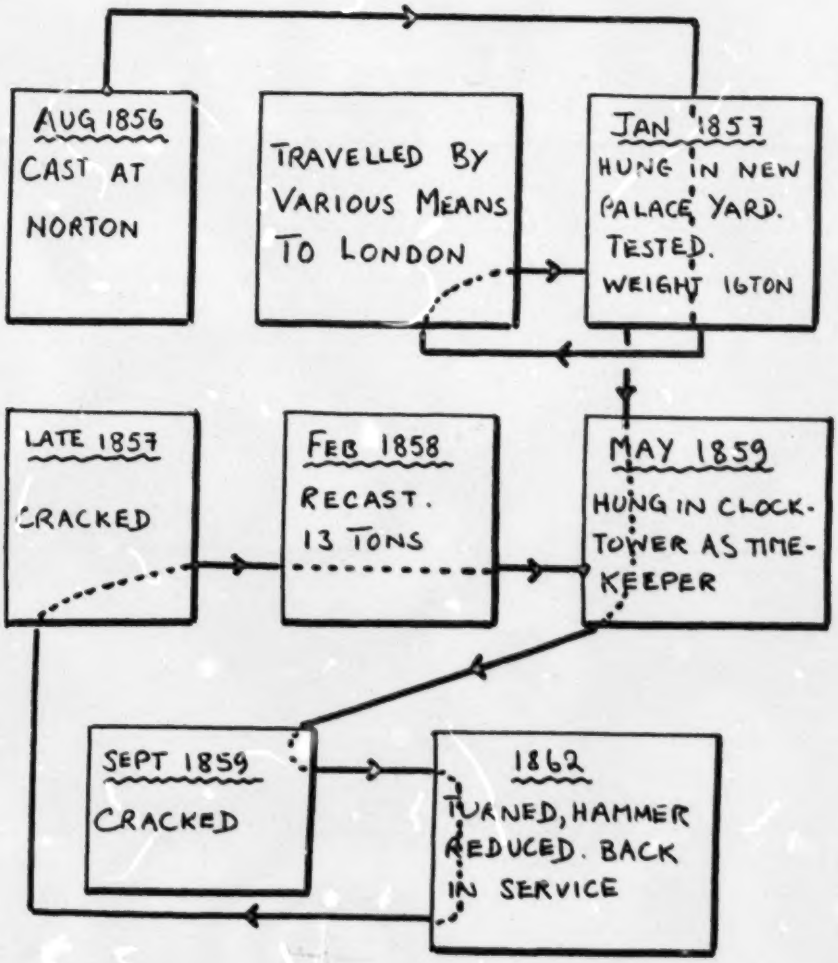
It had a varied journey from Norton to London and first went to West Hartlepool by rail. There it was loaded on to a ship which it badly damaged by dropping too suddenly on to the deck. When it arrived in the Port of London it was pulled across Westminster Bridge on a truck by sixteen white horses.

During its development Big Ben was to suffer two cracks. It was placed in the Clock Tower in 1859 and its first day of service as a time-keeper was probably 31st of May of that year. In September the bell cracked and remained silent for three years during which time there was much argument about the cause of the crack. The solution was to give the bell a quarter turn so that it offered a different striking surface to the hammer and the weight of the hammer was reduced. This was a much less drastic solution than that following the four-foot-long crack that had appeared towards the end of its year in New Palace Yard. Following this crack the bell was melted down and reproduced in a slightly smaller form in February 1858. It was now nine feet in diameter and three tons lighter. In May of the following year it was hauled up into the clock tower in Westminster and suspended on enormous iron girders.

J. Cooper. Think and Link. Edward Arnold, 1976, p.13.

If, after quickly reading, asked which crack occurred first, the large or the small, the standard response is the small one even amongst a learned audience (reading age of the passage is between 13-16 years depending on the test used). However a view of the I.S. and its realisation reveals why.

Realisation: process -chronological



A difficult realisation, if not adequately explicitly marked, makes full understanding not easy.

What devices are used to relate the I.S. with its realising surface structure? The obvious answer is those detailed by Halliday and Hasan (1976).

conjunction

reference

substitution

ellipsis

lexis

but it is also necessary to either extend this framework or to include some unusual realisations of these classes e.g. are 'first', 'second', 'then', 'next', conjunctions? and what about 'prior to this', 'earlier we noted', 'before this' and so on.[1]

Before moving on to the final question of applications possibly a number of caveats should be made.

Firstly, I.S. are suitable for analysis at paragraph level. Uniting I.S. beyond this is very difficult because of size and complexity. The purpose of I.S. is to simplify by reduction and organisation. By the very nature of things very large I.S. are generally self-defeating. Further, it is quite possible that whilst paragraphs and chapter are hierarchically organised, books and essays are heterarchial.

Secondly, initially perceiving I.S. is difficult as the surface apparently linear construction seems to dominate. With practice however I.S. can be perceived beneath these. Sometimes, however, I.S. are virtually impossible to identify even though they are present, either because of complexity or just plain bad writing. The latter I don't have time to consider. Complexity can be explained briefly. The I.S. considered so far have generally been simple ones. Frequently they occur in compound or complex forms. A compound I.S. is when two I.S. are joined together cons-

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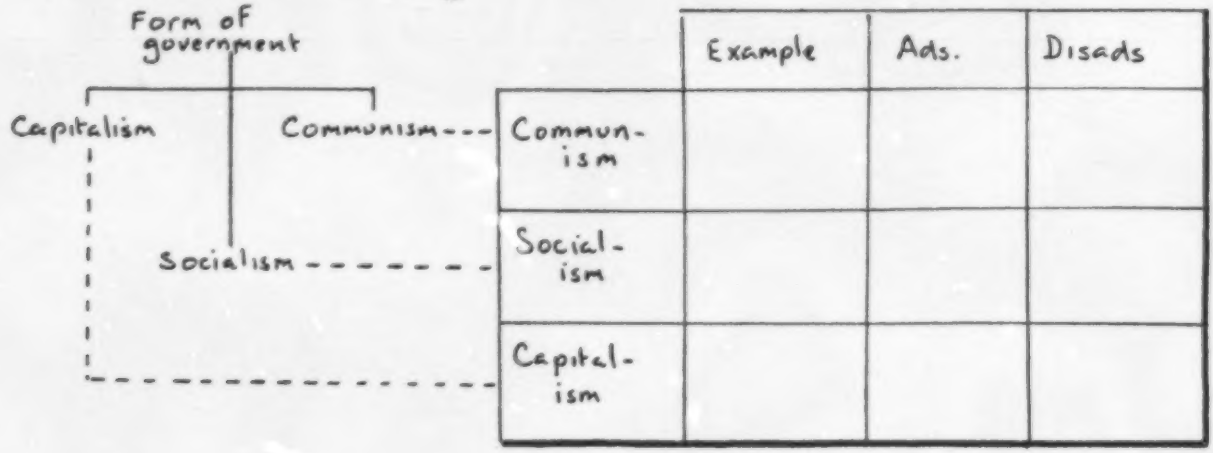
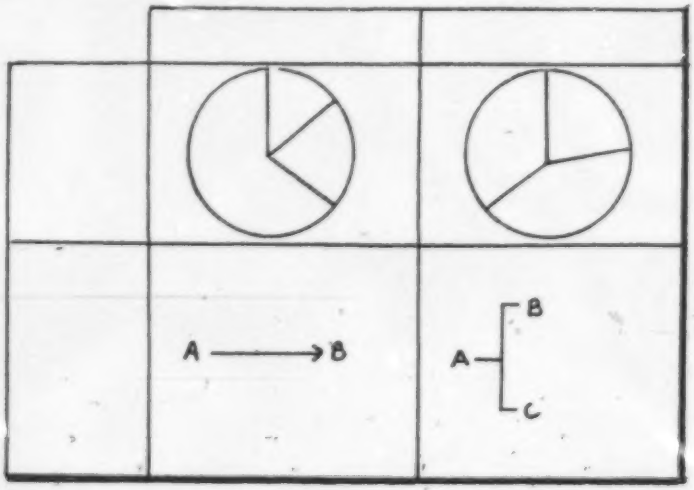
[1] See de Beaugrande and Dressler, 1981.

ecutively to make a larger unit. For instance, the matrix is virtually always preceded by a constitutive.



A complex I.S. occurs when one I.S. is embedded in another because of the organising nature of I.S., a not uncommon procedure.



Single embeddings are easy to handle, but multiple embeddings within embeddings are as difficult to handle here as they are within syntax. (Though in fact they may provide the best model of a complete discourse).

Finally, how might I.S. be used within Applied Linguistics? My own interests lie within EFL and ESP so most applications clear to me lie in these fields. However, I hope and suspect there may be wider applications.

My first awareness of I.S. came from reading an article by Johns (1980) "The Message and the Text" where he suggests that I.S. may be of value in teaching the reading of academic texts to overseas university students. Those who have attempted this technique have been generally very pleased with the results in connection with this skill. At a more general level, it seems intuitively attractive in providing a possible framework for the 'prediction' aspect of psycholinguistic theories of reading such as those of Smith (1973)

Recently my studies have led me to devise writing materials for similar students finding I.S. a suitable framework to provide both a curriculum:

1) The student must be able to negotiate all basic forms and the various combinations of I.S. and materials.
2) I.S. provide both a pedagogic device and a source of exercise, by presenting either:
   a) the same I.S. and considering different realisations
   b) using different I.S.
   c) using more difficult (compound and complex) I.S. as a basis for materials.

Staying with the subject of reading Perera (1980), in an article in "The Assessment of Linguistic Difficulty in Reading Material" suggests that present Readability Formulae provide only an inadequate measure and quotes a number of other authors in support of this, concluding that subjective assessment by the teacher must buttress present inadequate readability formulae that operate at word and sentence level. The earlier article 'Big Ben' with no particularly complex sentence structure or word length proved very difficult for most people to read with full understanding because of the complexity of the realisation of the I.S. On various measures of readability, however, it is deemed suitable for a reading age of 13 - 16 years. It would seem plausible to suggest that in I.S. we have a

suitable tool that may contribute to a new method of assessment of reading difficulty at a level above that of word or sentence, that will supplement existing tests.

The same problem from a different aspect is mentioned by Johns (ibid) from whom I quote:

> "There has in this century been a distaste among linguists and applied linguists for labelling language as good or bad, however the nature of pragmatic prediction (based on I.S. (F.C.)) may allow us to put such value judgements of a securer basis, the 'bad' text ... being one in which the writer fails to set up a basis for reader prediction, or fails without apparent reason to fulfill the predictions he appears to set up."

Additionally, seen this way I.S. may be a less subjective, though rather painstaking method of judging or grading essays.

Another possible application of I.S. that yet requires further research is inferred in a footnote in Johns (ibid):

> "It may be suggested not too seriously that the particular prevalence of matrix structures in texts in the field of administration may derive from the tendency of writers on adminstration themselves to be administrators and for the matrix to be particularly attractive to the methodical and pigeon-holing bureaucratic mind."

Despite the light-heartedness of this comment it does seem reasonable to expect the same methodological nature, but with different structures, to arise in different types of writing, say, for example, causative structures in physics, and taxanomic constitutive trees in biology; or there may be different patterns of compound and complex I.S. in various types of text. Bearing in mind the general failure of studies in register analysis to find adequate parameters(Porter (1976)) I.S. may be an interesting alternative area of study. Different registers may be compared for different I.S., different levels of complexity, and 'size of box'.

Finally, there are areas where I.S. may have application but where I am not really competent to comment. The idea of I.S. may have value in

psycholinguistics as they seem to be only higher order representations of templates being presently studied in natural cognitive development where the perceived world is considered as structured information.

Again certain attempts are being made to include I.S. as a model in at least one school of translation, but it is too early yet to comment on results there.

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